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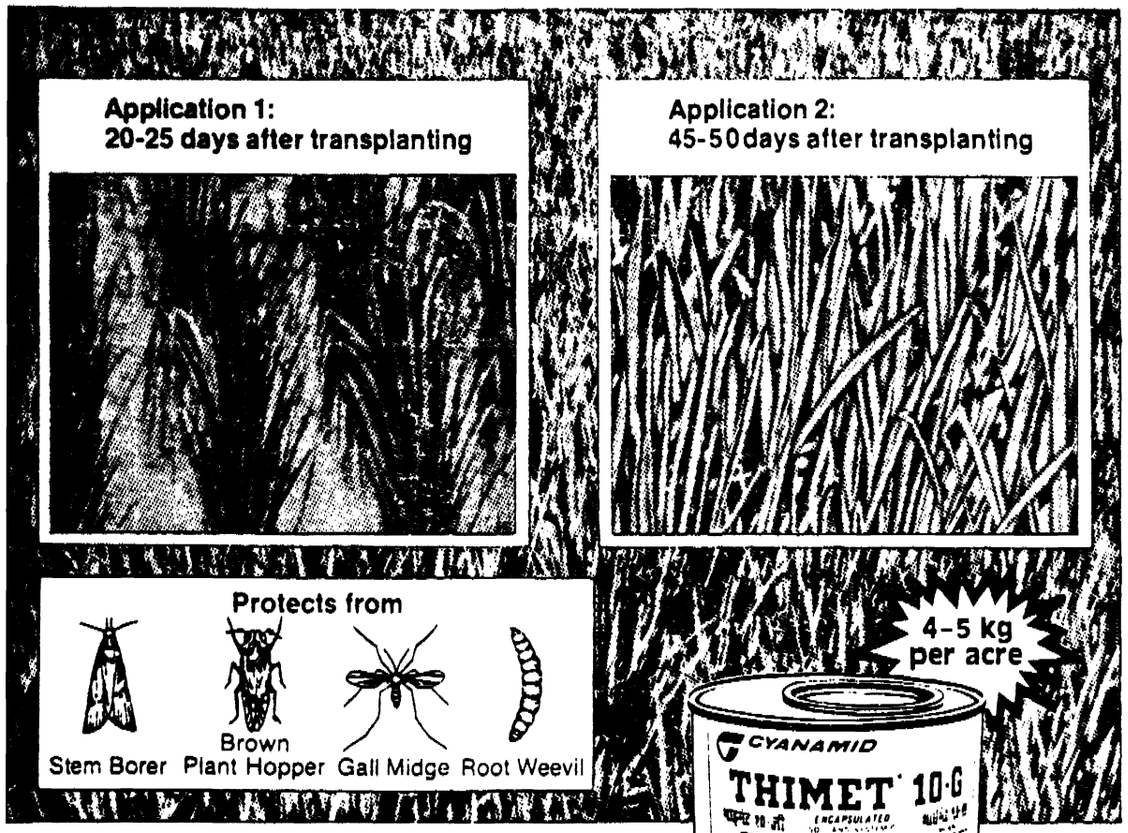

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INSECT PESTS OF GROUNDNUT IN INDIA AND THEIR MANAGEMENT

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1. INTRODUCTION

Groundnut, *Arachis hypogaea* L. is widely grown in India as a source of edible oil. The oil is used entirely for human consumption. The cake is exported to many European countries as cattle feed. Haulms are fed to cattle. Although India is the largest producer of groundnut, the current production of 6.56 million tons falls far below the domestic demand. The shortfall is made up by importing edible oil at a large cost to the national exchequer. Groundnut is now grown in 1.22 million ha during the rabi (postrainy) season in addition to 6.53 million ha in the kharif (rainy) season (Anon. 1985a).

It is grown in India mainly as a sole crop and is occasionally intercropped with sorghum, pearl millet, or pigeonpea. The practice of groundnut cultivation in India is currently changing because the Government has decided to encourage farmers to grow this crop by providing credit, subsidies on seed, pesticides and fertilizers, supply of water through major and minor irrigation projects, and an assured support price. The year round cultivation of groundnut encourages the carry over of pest populations resulting in increased pest damage and increased dependence on insecticides.

Although groundnut is the host of over 70 species of insects and mites in India only a few are pests of economic importance over wide areas (Table 1). The groundnut leafminer, *Aproaerema modicella* Dev. is widespread in southern and central India and causes severe damage. The white grub. *Holotrichia consanguinea* Blanch. is a dominant soil pest in northern India. A species of thrips, *Frankliniella schultzei* (Trybom) has assumed importance in recent years because of its role in spreading bud necrosis disease (BND) which is now widespread in India. There are at least six other pest species that are serious in different regions of India (Table 1).

This paper reviews the current status of research on the major groundnut pests, their biology and distribution, damage, control methods and the potential of integrated pest management (IPM) for the small growers.

2. EXTENT OF LOSSES AND ECONOMIC THRESHOLD

There is little quantitative information on the extent of losses caused by various pests. The available information based on the results of trials conducted on reserach farms is given in Table 1.

The information on economic threshold levels (ETL) is scant. For white grub,

an ETL of 19 adult beetles on nearby shrubs and trees has been reported (Raodeo and Deshpande, 1981). Three egg masses of *S. litura* per 15 m. or 7 larvae per meter row have been shown to reduce pod yields by 700 kg / ha and of haulms by 600 kg/ha (Anon., 1984 p. 316). Tejkumar (1979) reported that every 1% infestation by leaf miner larvae resulted in 1.24 to 1.27% yield loss. He estimated 2 larvae/plant as the ETL. An ETL of 2 leafminer larvae/plant has also been reported at Vriddhachalam (Anon. 1985, p 345). Radhakrishnan *et al* (1982) observed that 1% increase in the leafminer incidence reduced the dry pod yield by 9.3 kg / ha. Intensive studies to formulate ETL of the leafminer are in progress at ICRISAT. Information on ETL for other pests is not available.

3. BIOLOGY AND ECOLOGY

3.1. Soil pests

White grub: Several species of the genus *Holotrichia* attack groundnut. The grubs kill the plants by damaging the tap root. Beetles emerge from soil at dusk after heavy premonsoon or monsoon rains in June, and fly to nearby shrubs and trees, e.g. neem *Azadirachta indica*, where they mate and feed. They return to the soil at dawn and lay eggs. This process continues daily over a period of about 40 days from June to July. Prolonged drought reduces the emergence of beetles from the soil. A female lays 8 to 25 eggs. Young larvae feed on soil organic matter and then on plant roots, including those of groundnuts. The first larval instar is completed in 9-14 days, the second in 10-38 days and the third in 61-75 days depending on soil temperature. Pupation takes place in the soil in October and the pupal period lasts for 15-22 days. The adults remain in the soil until the next monsoonal rains (Brar and Sandhu, 1980).

Termites : Termite damage to groundnuts has been recorded from sandy soils of northern India where *Odontotermes obesus* Rambur is the dominant species. Termites damage groundnuts in two ways. *Odontotermes* sp. scarify the pods. This weakens the shells and makes them liable to the entry and growth of *Aspergillus flavus* that produces aflatoxins (McDonald and Harkness, 1967). *O. obesus* and *Microtermes* spp. penetrate and hollow out the tap root thus killing the plant (Amin and Mc Donald, 1979; Verma and Kashyap, 1980).

3.2. Foliar pests

3.2.1. *Sucking pests*

Jassids: *Empoasca kerri* Pruthi is the dominant jassid species on groundnuts in Gujarat, Maharashtra, and Tamil Nadu. Both adults and nymphs suck sap from leaves. The damage symptoms appear as a wedge shaped yellowing near the tip of the leaflet. A heavily attacked crop looks yellow. Eggs, which are inserted into the leaf tissue, hatch in 7 to 10 days. The nymphal period lasts for 7 to 14 days. Adults live up to 33 days.

High populations occur in August and September. Jassids are a minor pest in the postrainy season (Amin, 1982).

Thrips : Three species of thrips commonly attack groundnut, of which *Scirtothrips dorsalis* Hood is an important pest and *F. schultzei* a vector of BND. The third species, *Caliothrips indicus* (Bagnall) can become abundant in dry weather, particularly in summer crops. The injury symptoms caused by the three species are distinct (Amin and Palmer, 1985). Feeding by *S. dorsalis* results in brownish green patches on the upper leaf lamina and dark brown patches on the lower leaf lamina. Feeding by *F. schultzei* results in scars on the upper leaf lamina while *C. indicus* causes chlorotic spots on older leaves. The biology of the three species is similar. The eggs, which are inserted into the leaf tissue, hatch in 6 to 9 days, the first nymphal instar is completed in 2 to 3 days and the second in 2 to 4 days. The prepupal stage lasts for 1 to 2 days and the pupal period for 2 to 5 days. Adults live up to 33 days. A female can lay up to 40 eggs. *S. dorsalis* is active throughout the year, peak infestations occurring from July to September and February to March. *F. schultzei* migrates to groundnuts from nearby crops, weeds in August and September and again from January to March. Infestations by C. *indicus* are high on summer groundnut. All three species have a wide host range.

Groundnut aphid: *Aphis craccivora* Koch is a sporadic pest of groundnut. Both adults and nymphs suck the sap. Under heavy infestations, the plants become chlorotic and levaes curl. Aphids also infest the flowering stalks and pegs. Bakhetia and Sandhu (1976) recorded 31 overlapping generations in a year in Punjab with peak infestations from July to September. In Maharashtra and Andhra Pradesh high populations of aphids occur during July and August and in Madhya Pradesh in September. Aphid damage becomes serious in drought periods. Black ants *Camponotus compressus* F. have a symbiotic association with this aphid. Several parasites and predators, e.g., coccinellids destroy aphid populations. Moderate to heavy rainfall also reduces aphid populations rendering chemiacl control unnecessary.

A. craccivora is a vector of the Groundnut Rosette Virus in Africa. This disease, does not occur in India. *A. craccivora* transmitted viruses of groundnut, e.g., Peanut Mottle are not economically important in India.

3.2.2. *Defoliators*

Red hairy caterpillars

Among the three species of red hairy caterpillars, *Amsacta albistriga* Wlk. is the most common. Its moths emerge from pupae in the soil after the first heavy rains. They copulate soon after emergence and deposit 40 to 900 eggs in masses on crop plants, hedges, weeds or clods of earth. Eggs hatch in 3 to 4 days. Initially, the larvae are gregarious but disperse as they get older. The larval period is completed in 20 to 31 days during which time they can defoliate a wide range of host plants including groundnut. They pupate at a depth of 10 to 20 cm in soil under trees, hedges, shady corners of the field, or near bunds. Pupae remain in diapause, until the following rainy season. The

two related species, *A. moorei* Butl. and *Diacrisia obliqua* Hb. have a life cycle similar to *A. albistriga*. All three species are polyphagous (Nagarajan et al., 1975).

Groundnut leafminer

Moths lay single, white, shiny eggs on the young foliage. A female can lay up to 473 eggs with an average of 186 eggs. Young caterpillars mine the leaflets and feed in between the upper and lower epidermis. They then come out of mines, web the leaflets and continue to feed within the shelter they have created. Five larval instars are completed in 9 to 17 days. Pupation takes place inside the mines or in webbed leaves. The pupal period lasts for 3 to 7 days. Initially a few months infest the crop and the pest does not become abundant until the third or fourth generation. Heavy rains destroy leaf miner populations. Twenty five species of Hymenoptera parasitize the larvae. Parasitism ranging from 3 to 24% has been reported from Karnataka and 38 to 83% from Maharashtra. The leafminer has a restricted host range which include soybean *Glycine max* L. The leafminer can become serious in regions where large areas of groundnut and soybeans are cultivated in successive rainy and postrainy seasons (Mohammad, 1980).

Tobacco caterpillar

The tobacco caterpillar *Spodoptera litura* F. has been reported tc be a major pest on groundnuts since 1978 (Amin, 1983). An intensive study of its applied ecology i- in progress at ICRISAT. Egg masses containing about 40 to 400 eggs are laid on leaves. Eggs are covered with scales from the female's body. They hatch in 3 to 4 daye. Six larval instars are completed in 15 to 21 days. Pupation takes place in the soil a' a depth of five cm or underneath leaf debris. Adults emerge in about 10 days. The larvae are polyphagous.

4. COMPONENTS OF PEST MANAGEMENT

4.1. Cultural practices

Groundnut is cultivated over large areas as a sole crop, so intercropping has little scope for adoption. Early sown crops tend to escape from pests and diseases (Logiswaran et al., 1982; Reddy et al., 1983). The optimum plant density (ca. 3 million / ha for erect bunch genotypes and 0.2 million / ha for runner genotypes) ensures high yields of groundnut. This practice also reduces the pest damage and BND incidence (Reddy et al., 1983). However, the plant density in farmers' fields is generally below the optimum (Amin and Reddy, 1983) largely due to seedling mortality caused by soil pathogens. Dressing of seeds with fungicides can reduce seedling mortality and ensure optimum plant density. A combination of early sowing, optimum plant density and use of thrips resistant cultivars, e.g., Kadiri 3 considerably reduces BND incidence and ensures higher yield (ICRISAT Annual Report, 1981, p. 174-175).

4.2. Machanical control

Large scale collection and destruction of white grub beetles has reduced the subsequent damage to groundnut in Rajasthan (Kushwaha, 1976) and in Maharashtra (Roadeo and Deshpande, 1984). Campaigns to collect and destroy moths of the red hairy caterpillar and their egg masses has saved 75% of crop from destruction by this pest (Mukundan, 1964). Collection of egg masses of *S. litura* and digging of trenches to trap tobacco caterpillars which move from field to field can also be practised. Mass trapping of *Spodoptera* male moths in sex pheromone traps has not been shown to be effective in reducing subsequent damage from this pest.

4.3. Host plant resistance

Groundnut genotypes possessing resistance to various pests are listed in Table 2. Resistance to jassids has been identified. In some genotypes it is associated with long hairs on the leaf lamina (Amin et al., 1985). The inheritance of this trait is controlled by additive as well as nonadditive gene effects (Dwivedi et al., 1985). Several genotypes with resistance to *F. schultzei*, the vector of BND, have been identified (Amin et al., 1985). These incur low incidence of BND although they are not resistant to the virus. Among the released cultivars, ICG 156 (M 13), ICG 799 (Robut 33-1), and the recenlty released ICGS 11 have comparatively low levels of BND incidence due to resistance to *F. schutzei* (Amin, 1985). Resistance to pod scarifying termites, *Odontotermes* sp. has been identified (Amin et al., 1985). Differences in susceptibility to the leafminer have also been observed (Anon. 1984-85, p. 98).

Resistant genotypes are now being utilized in breeding programs of ICRISAT and AICORPO. The genotype ICG 2271 is being extensively used because of its resistance to a range of pests, good agronomic characters and high yield potential. However it matures in 120-130 days which is too long for many areas. Additional genotypes with resistance to more than one pest but with undesirable agronomic characters are also being used in breeding program at ICRISAT. Efforts are being made at ICRISAT to incorporate resistance into early maturing varieties. As the existing spanish varieties are highly susceptible to BND, attempts are being made to incorporate *F. schultzei* resistance into them.

4.4. Natural enemies

Although parasites, predators and microbial pathogens of various insect pests have been listed (Table 3), quantitative information on the extent of control they achieve of the pests is lacking. Parasites take a heavy toll (14 to 83) of the leaf miner larvae (Kothai, 1974; Khan and Raodeo, 1978) and are of potential importance (J.A. Wightman, ICRISAT, personal communication). The role of coccinellids in reducing *A. craccivora* populations is known, but has not been exploited (Khan and Hussain, 1965). Although several species of parasites and predators attack larvae of *S. litura*, they are not effective in controlling this pest. However, the potential of insect pathogenic viruses, e.g., nuclear

polyhedrosis virus, needs to be determined. Because viruses are not affected by insecticides, they can be integrated in pest management programs.

4.5. Chemical control

The available information on pest control with insecticides is summarized in Table 4. White grubs can be controlled by phorate applied with seed @ 1 to 2.5 kg ai /ha but the cost is prohibitive. Termites can be controlled by seed dressing with insecticides (Sands, 1973). Sucking pests can be controllted by systemic insecides such as dimethoate, demeton—S—methyl, and monocrotophos. Leafminer can be controlled by carbaryl, chlorpyriphos or monocrotophos. At ICRISAT, one spray of dimethoate @ 200 g ai / ha in 300 L of water gave an excellent control when the spray coincided with the emergence of second generation moths. *S. litura* larvae can be controlled by monocrotophos 350 g ai / ha or carbaryl 850 g ai / ha in 300 litres of water, particularly if insecticides are applied when egg masses are noticed. This is because, young larvae are easier to kill than the older larvae. The use of baits made up of 125 ml monocrophos + 1 kg jaggery + 10 kg rice bran gave 44% mortality of *S. litura* larvae and 25% more yield when compared with plots where bait was not applied (Anon., 1984, p. 307). Hairty caterpillars can be controlled by several contact insecticides (Nagarajan et al. 1959).

Application of insecticides on groundnut has been traditionally carried out with knapsack sprayers which requires 300-500 L of spray mixture / ha. However, new controlled droplet applicators (CDA) require less than 15 litres of spray mixture per hectare and are easy to operate (Anon. 1985, p. 337-338). Although CDAs are available in India, the correct insecticide formulations are not. The EC formulations can be used by making an emulsion in water to which crystal sugar is added to minimise the evaporation of the fine droplets before they fall on the foliage (Pawar et al., 1984).

Groundnut generally requires protection from 30 to 70 days after sowing and this leaves about 25 to 30 days between the last spray and the harvest. Therefore, the pesticide residues are not likely to exceed tolerance limits. However, later application of pesticides to control some pests, e.g., leafminer, may create residue problems. Therefore, ways to reduce the residue risks from later application of insecticides should be studied.

5. CURRENT PEST CONTROL RECOMMENDATIONS AND SCOPE FOR ADOPTION ON FARMERS FIELDS

Current reliance on insecticides for pest control results from the lack of alternative control methods. The economic thresholds should be developed for individual pests to make insecticide application more effective and economic.

Cultural practices are easily adopted by the farmers if they fit into cultivation practices. Although early sown crops have less pest and BND problems, sowing depends upon the onset of monsoonal rains and cannot be altered. High seeding rates cannot be adopted because seed is the costliest input in groundnut cultivation. Alternatively, reducing seedling mortality by fungicidal seed dressing can be adopted.

Although mechanical control by organized large scale campaigns to destroy white grub beetles and hairy caterpillar moths are effective, these cannot be practiced by individual farmers. Destruction of egg masses of *S. litura* and *A. albistriga* can be easily done in small fields. Control of *S. litura* larvae by using baits has been adopted by some farmers in Andhra Pradesh.

Pest resistant cultivars would be readily taken up by the farmers provided the are high yielding and also have other desired crop characters. M 13, Kadiri 3 and ICGS 11 have been released in India. These have field resistance to BND, and M 13 is also resistant to jassids, thrips and to some extent to the leafminer.

Biological control is difficult to adopt and may not always be compatible with the current dependence upon insecticides.

6. PEST MANAGEMENT RECOMMENDATIONS

Integrated pest management (IPM) is an achievable goal. The IPM should be based on resistant cultivars, optimum planting time and plant density, and minimum use of pesticides (Table 5).

7. NEED FOR FUTURE RESEARCH

1. Information on the losses caused by various pests in farmers fields should be collected.
2. Detailed studies on the applied ecology of various pests of groundnut in relation to the cropping systems should be carried out.
4. Research on more effective use of pesticides and appliances and pesticide residues is required.
5. Intensive research on developing multiple pest resistant cultivars with good agronomic characters particularly in the spanish background is required.
6. Research on cultural practices that reduce the pest infestation and also fit into existing cultivation practices should be carried out.
7. Integrated pest control involving resistant varieties, cultural practices and minimum use of insecticides based on ETLs needs to be formulated.

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Table 1. Details of the common insect pests of groundnut and associated yield losses.

Common name & Scientific name	Plant part damaged & Extent of loss	Period of abundance	Off season survival	States in which of most concern*
White grubs *Holotrichia* spp.	Roots 30-100%	Aug-Oct	Diapausing beetles in soil	Haryana, Punjab, Rajasthan, U.P., Maharashtra
Termites *Odontotermes obesus* Rambur	Roots, pods 5-53%	Sep-Oct	Active throughout the year	M.P., Haryana, U.P., Gujarat, Punjab
Odontotermes spp.	Mature pods Allows entry of fungi including *A. flavus*	Oct-Nov	Active throughout the season	Not known
Jassid *Emposaca kerri* Pruthi.	Foliage 9-22%	Aug-Oct Also on summer groundnut	On leguminous crops, weeds	Maharashtra, Gujarat, A.P., Tamil Nadu
Thrips *Scirtothrips dorsalis* Hood	Foliage 17-40%	Jul-Ap	Weeds and crop plants	Orissa, Karnataka.
Frankliniella schultzei (Trybom)	Foliage Spreads BND Upto 90% from BND	Aug-Sep Jan-Feb	On weeds/crops	BND is serious in A.P., Karnataka, Maharashtra, Gujarat, U.P. Haryana
Aphids *Aphis craccivora* Koch.	Foliage 16-42%	Jul-Sep Become abundant in drought years	Other legumes	Gujarat.
Leafminer *Aproaerema modicella* Dev.	Foliage 24-92%	Throughout the year	Groundnut to groundnut/ soybean	Tamil Nadu, A.P., Karnataka, Maharashtra and Gujarat
Hairy caterpillars *Amsocta* spp *Diacrisia obliqua* Hb.	Foliage 26-100%	June-Oct. (sporadic)	Diapausing pupae in soil	Tamil Nadu, A.P., Karnataka
Tobacco caterpillar *Spodoptera litura* F.	Foliage 13-71%	Jan-Apr	Many crop plants	A.P., Karnataka,

*A.P. = Andhra Pradesh, M.P. = Madhya Pradesh, U.P. = Uttar Pradesh

Source : Amin (1983); Amin and Reddy (1983). Annual Progress Reports of the All India Coordinated Research Project on Oilseeds, Directorate of Oilseeds Research, Rajendra-Nagar, Hyderabad. 1978-85.

Table 2. Sources of resistance to insect pests of groundnut.

Insect	Cultivars	States where recommended	Reference
Termites :			
Odontotermes sp. (pod scarifying termites)	ICG 156, ICG 2271, ICG 5043, ICG 5044, ICG 4045, ICG 5071, ICG 6317, ICG 6764	ICG 156 (M 13) is a released variety	Amin et al., 1985
Jassid	ICG 156, ICG 2271, ICG 2306, ICG 2307, ICG 2741, ICG 5040, ICG 5041, ICG 5042, ICG 5045, ICG 5043, ICG 5044, ICG 6317, ICG 6764		Amin et al., 1985
Thrips :			
F. schultzei	ICG 56, ICG 2271, ICG 2306, ICG 2307, ICG 2220, ICG 5036, ICG 5041, ICG 5042, ICG 5043, ICG 5044, ICG 5045, ICG 6764,		Amin et al., 1985
Bud necrosis	ICG 156, ICG 799, ICG 2271, ICG 2741, ICG 5036, ICG 5044, ICG 6764, ICGS 11	ICG 156, ICG 799 (Robut 33-1 and ICGS 11 are released in India)	Anon. 1984, p. 298
Leafminer	ICG 57, ICG 156, ICG 541, ICG 1440, ICG 1697, ICG 2248, ICG 6544, ICG 7016, ICG 7018, ICG 7184, ICG 7381, ICG 7404, ICG 9116, ICG 9862, ICG 9883	ICGS 156 (M 13) is a released variety	Anon. 1984-85, p. 98

Table 3. Natural enemies commonly reported on insect pests of groundnut.

Insect	Natural enemy*	Family	Stage affected	Period of activity	Extent of mortality
White grub *Holotrichia* sp.	*Anthia sexguttata* (F.) (PR)	Carabidae	Larva	Jul-Sep	—
	Bacillus popillae Dutky (P)	—	,,	Jul-Feb	Upto 18%
	Beauveria bassiana (P)	—	,,		
	B. bronginartii (Sacc.) (P)	—	,,		
	Campromeris collaris (F.) (P)	—	,,	Aug-Sep	Upto 5%
	Metarrhizium anisopliae (Metch.) (P)	Scolidae	Adult	Jun-Jul	
	Scolia aureipennis Lep. (PR)	Sturnidae	,,	,,	
	Bufo melanosictus (L.) (PR)	Corvidae	,,		
	Corvus splendens Vici. (PR)				
Groundnut jassid *E. kerri*	*Orius maxidentex* Ghauri (PR)	Anthocoridae	Nymph/Adult	Sep-Oct	—
Thrips *S. dorsalis*	*Franklinothrips megalops* (Trybom) CPR)	Aelothripidae			
	Orius spp. (PR)	Anthocoridae			
	Scolothrips indicus Pries (PR)	Thripidae			
F. schultzei	*Orius maxidentex* Ghauri (PR)	Anthocoridae	Nymph/Adult	Aug-Sep	—
C. indicus	*O. maxidentex* Ghauri (PR)	,,	,,	,,	
Groundnut aphid *A. carccivora*	*Aphelinus basalis* West. (P)	Aphelinidae	,,	—	
	Aphidencyrtus aphidivorus (Mayr.) (P)	Encyrtidae	,,	—	
	Aphidius absinthii Marshall (P)	Aphidiidae	,,	Aug-Sep	
	Brumoides suturalis (F.) (RP)	Coccinellidae	,,	,,	
	Chilocorus nigritus F. (PR)	,,	,,	,,	
	Chrysopa carnea Steph. (PR)	Chrysopidae	,,	,,	
	Coccinella spp (PR)	Coccinellidae	,,		
	Ischiodon spp (P)	Syrphidae	,,		
	Lysiphlebus fabarum Marsh (P)	Ichneamonidae	,,	Jun-Sep	Very high
	Menochilus sexmaculatus (F.) (PR)	Coccinellidae	,,		
	Orius sp. (PR)	Anthocaridae	,,		
	Paragus spp. (P)	Syrphidae	,,		
	Sphaerophoria scutellae (F.) (PR)	Syrphidae	,,		
	S. javana Wedi. (PR)	,,	,,		
Leafminer *A. modicella*	*Trichogramma* sp. (P)	Trichogrammatidae	Egg	Jul-Oct	
	Apanteles spp (P)	Braconidae	Larva	Aug-Sep	Upto 83%
	Brachymeria sp. (P)	Chalcididae	,,	Sep-Feb	11-44%
	Bracon spp (P)	Braconidae	,,	Aug-Nov	3-24%
	Capidosoma sp. (P)	Encyrtidae	,,		
	Chelonus spp. (P)	Braconidae	,,	Oct	
	Ceraphron sp. (P)	Caraphronidae	,,		
	Elasmus brevicornis Gah. (P)	Elasmidae	,,	Aug-Sep	
	Goniozus stomopterycis (P)	Bethylidae	,,		
	Pediobius sp. (P)	Eulophidae	,,		
	Perisierola sp. (P)	Bethylidae	,,		
	Phanerotoma sp. (P)	Braconidae	,,		
	Tetrastichus sp. (P)	Eulophidae	,,	Aug-Feb	4-59%
Red hairy caterpillar *A. albistriga*	*Telenomus manolus* (Nixon (P)	Scelionidae	Egg	,,	
	Trichogramma chilonis Ishri (P)	Trichogrammatidae	Egg		
	Bacillus cereus (P)	—	Larva		
	Cantheconida furcellata (Wolff.) (PR)	Pentatomidae	,,		
	Exorista civiloides Baranoff (P)	Tachinidae	,,		
	Strumia inconspicuella Baranoff (P)	,,	,,		
A. moore	*Apanteles bosei* Bhat (P)	Braconidae	,,		
	Apanteles creatonoti Vier (P)	,,			
	Carcellia evolens Town (P)	Tachinidae	,,		
	Mermes indica V. (P)	Mermithiidae	,,		
	Strumia sp. nr. *inconspicuella* Baranoff (P)	Tachinidae	,,		
	Tachina fallax Meigan. (P)	,,	,,		
Bihar hairy caterpillar *D. obliqua*	*Apanteles* spp.	Braconidae	,,		24%
	Carcellia sp. (P)	Tachinidae	,,		6%
	Rhinocoris fuscipes (F) (PR)	Reduviidae	,,		
		Braconidae	Egg		5-10%
		,,	Egg/Larva		0-48%
Tobacco caterpillar *S. litura*	*Chelonus* spp.	Scelionidae	,,		
	Nasidiocoris tensis (PR)	Braconidae	Larvae		Upto 40%
	Telenomus remus Nixon (P)	Eulophidae			
	Apanteles sp. nr. *colemani* (P)	—	,,		
	Euplectus copimohani Mani (P)				
	Nuclear polyhedrosis virus				

Source : Amin (In press) Mohammad (1980).
*** P = Parasite or Pathogen; PR = Predator**